

Alternative Fuel Engines for 1998



Engine and Vehicle Fuel Systems

- Dedicated and Flexible Engines:
 - electronic lean-burn closed-loop control (oxygen sensor)
 - Cummins designed sub-systems (electronics, ignition, air / fuel)
 - CNG or LNG - maximum fuel tank usage:
 - » 60 psig minimum L10G & C8.3G (50 psig min. B5.9G)
 - tailor for other gaseous fuels - HD-5 Propane
 - » 35 psig minimum B5.9LPG (for cold ambients)
- Vehicle Fuel Systems:
 - SAE J2343 “Recommended Practices for LNG-Powered Heavy-Duty Trucks”
 - buses and other vehicle applications in process - NGV Industry
- Medium- & Heavy- Duty NGVs Availability Bullentin
{GRI 12/96 rev. (773) 399-8239}

Diesel-Based Platforms

- High volume products - lower costs
- Latest product and manufacturing for both S.I. and diesel
- Maximum parts commonality:
 - » engine liners (C8.3 & L10) and block
 - » crankshaft, camshaft & bearings
 - » overhead and geartrain
 - » similar cylinder head
 - » pumps and filters (oil / water)
 - » air compressor, starter and flywheel housing / flexplate

Dedicated Spark-Ignited Gaseous Fuel

- Diesel-based platforms with following exceptions:

INCLUDE

Gaseous Fuel System
CM420 Controller
Lower CR Piston & Rings
Spark Plugs
Spark Ignition Cylinder Head
Water-cooled Wastegate Turbo
Ignition System
Exhaust Oxygen Sensor

EXCLUDE

Diesel Fuel System
Diesel ECM
Diesel Piston & Rings
Diesel Injectors
Diesel Cylinder Head
Diesel Turbo

L10-300G Engine Status

- Third product enhancement since 1990
- Production available since January 1996; 300 & 280 Hp (224 & 209 kW) ratings with 900 ft-lb torque peak
- Closed-loop electronic engine management:
 - Cummins integrated sub-systems: ignition, air / fuel handling
 - electronic throttle (drive-by-wire)
 - maximum parts commonality with B5.9G and C8.3G engines
- Applications: transit / express bus, refuse / regional haul truck
- Over 1485 engines built with 130M miles (210M km) in revenue service as of June 1997; includes 585 electronic L10G engines

L10G NGV OEM Availability

Transit / Coach

Gillig

Ikarus (Hungary)

Neoplan (Germany & NA)

NABI (Ikarus NA)

NovaBUS

Orion Bus

Refuse

Crane Carrier

Peterbilt 320

Volvo WX

H.D. Truck

ERF (UK)

Kenworth T800

C8.3G Engine Status

- Production since January 1996
- 250 Hp (186kW) with 750 and 660 ft-lb torque peak ratings
- Closed-loop electronic engine management:
 - coil-on-plug ignition sub-system
 - Cummins integrated air / fuel handling sub-system
 - electronic throttle (drive-by-wire)
- Applications: school / shuttle / transit bus; refuse / P&D truck
- Over 115 engines built with 1M miles (1.6M km) in revenue service as of June 1997
- 275 Hp (204kW), 750 ft-lb torque peak rating available January 1998

C8.3G NGV OEM Availability

School / Shuttle / Transit

Berkhof (Netherlands)
Dennis Specialty (UK)
El Dorado National
Ikarus (Hungary)
Neoplan (Germany & NA)
NABI (Ikarus NA)
NovaBUS
Orion Bus
MetroTrans
Thomas Built

Refuse

Crane Carrier
Dennis Eagle (UK)
Seddon Atkinson (UK)

H.D. Truck

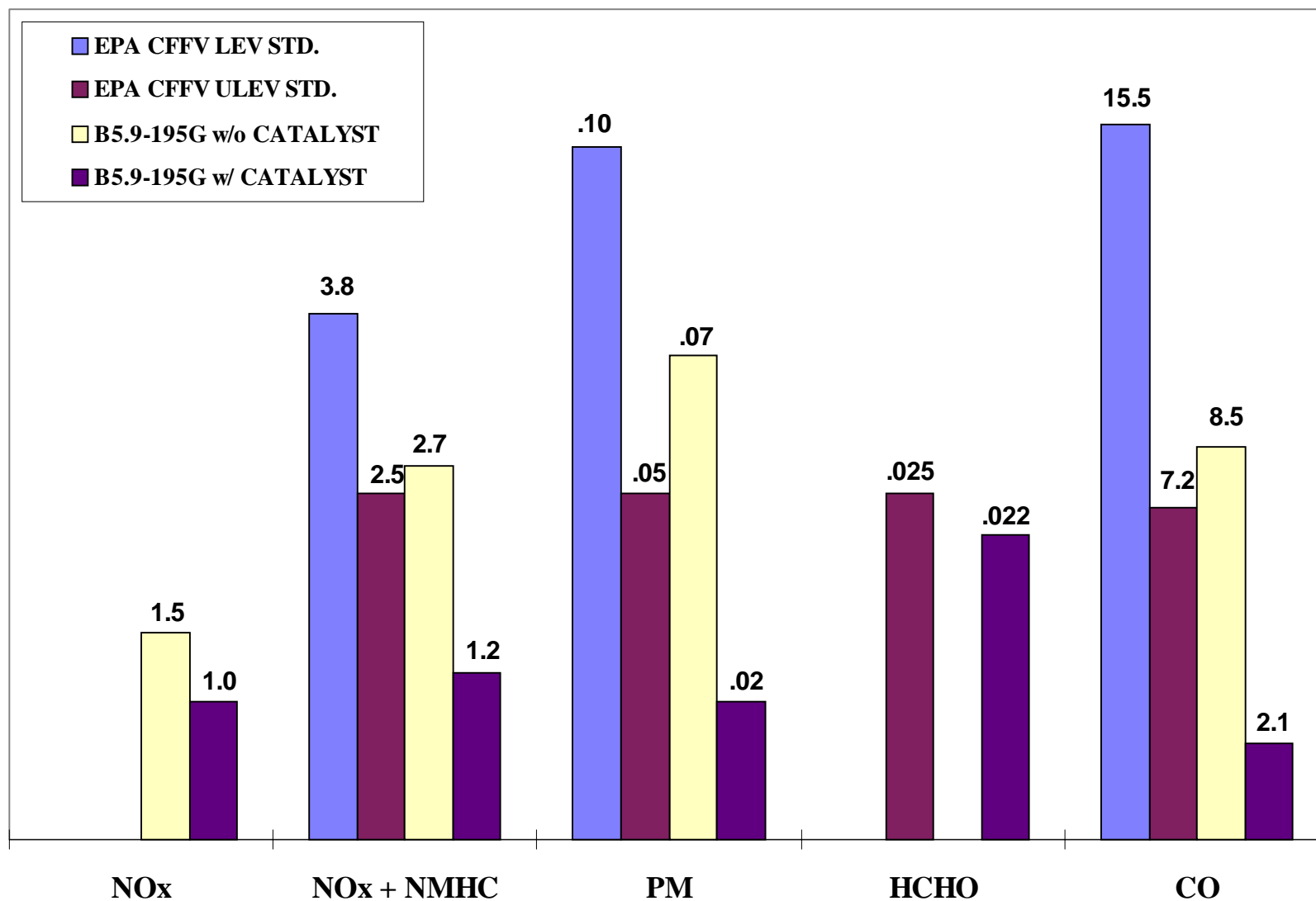
Iveco (Aust)
Freightliner

B5.9G Engine Status

- Production availability since 1994; 195 and 150 Hp (145 & 112 kW) with 420 and 375 ft-lb torque peak ratings, respectively
- Closed-loop electronic engine management:
 - Cummins integrated sub-systems: ignition, air / fuel handling
- Emissions certifications:
 - EPA CFFV ULEV w/ catalyst, LEV w/o catalyst
 - CARB Optional Low NOx
- Applications: school / shuttle bus, recycle / sweeper / P&D truck
- Over 500 engines with 6M miles (9.7M km) in revenue service as of June 1997
- 230 Hp (171kW), 500 ft-lb peak torque rating available January 1998

1997 B5.9G EPA CFFV Certified Emissions

(g/bhp-hr)



B5.9G NGV OEM Availability

School / Shuttle / Transit

AutoSan (Poland)
Blue Bird
Cespele / EAG (Hungary)
Champion Coach
Chance Coach
Collins
Dennis Specialty (UK)
El Dorado National
Goshen Coach
Matthews Bus
MASA (Mexico)
Metrotrans
North American Transit
Neoplan (Germany & NA)
Optare (UK)
Orion Bus
Specialty Vehicles
Thomas Built
Van Hool (Belgium)

Medium-Duty Truck

ERF (UK)
Freightliner
Freightliner Custom Chassis
Leyland - DAF (UK)
Ottawa - yard spotter
SISU (NA) - yard spotter

Refuse

Crane Carrier
Elgin - sweeper
ERF (UK)
Tymco - sweeper

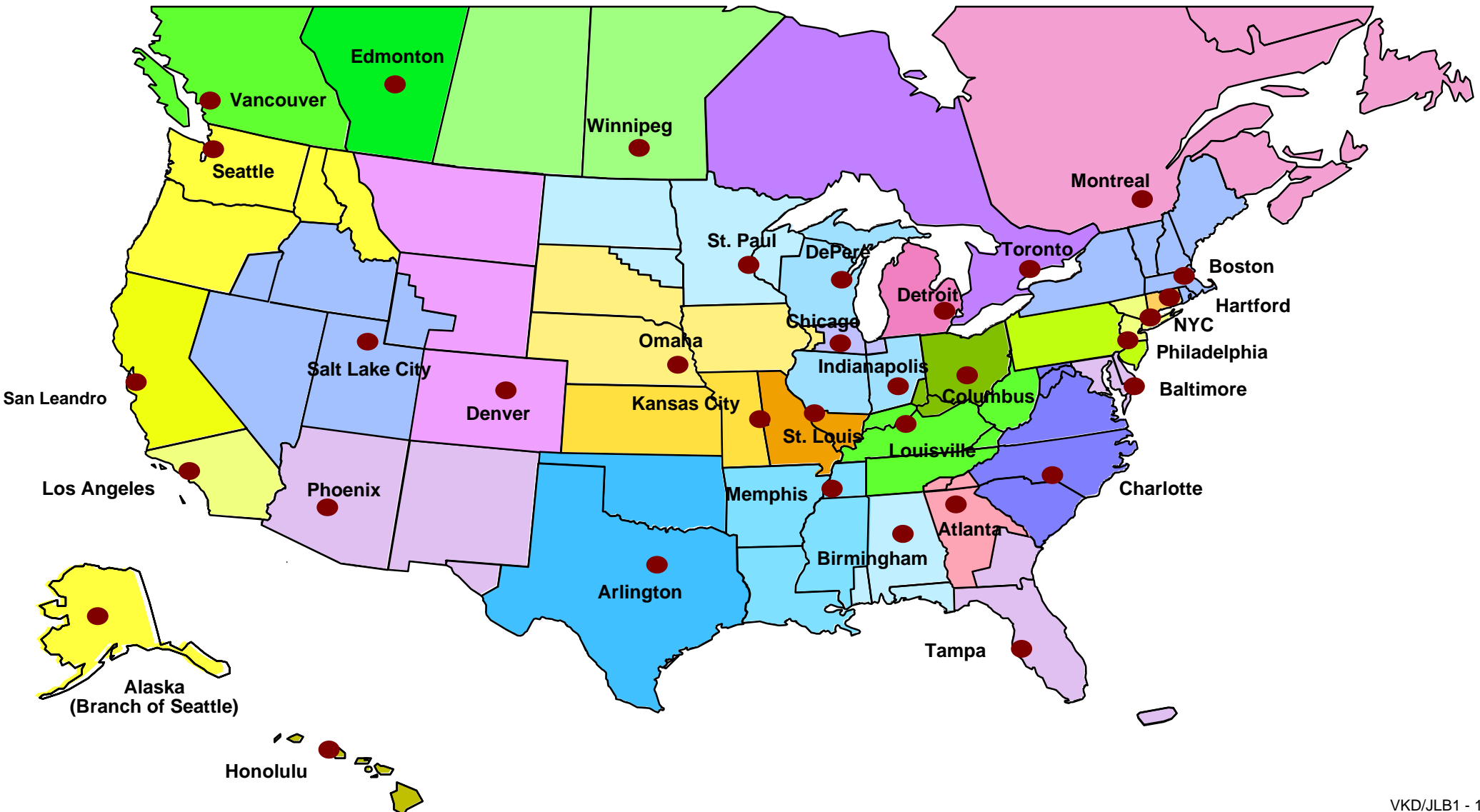
B5.9LPG Engine Status

- Performance and emissions targets demonstrated:
 - 195Hp (145kW) @ 2600rpm, 420ft-lb peak torque @ 1600rpm
 - 285 ft-lb @ 800rpm (WOT) clutch engagement torque
 - Emission Certification: EPA CFFV LEV with catalyst
- Designed for HD-5 motor fuel specification
- Engine-mounted LPG fuel system including vaporizer; requires 35 psig minimum vehicle fuel supply pressure for cold ambients
- Development experience to-date includes:
 - ten vehicles in revenue service with 180k miles (290,000 km)
 - over 45 engines with 9000 laboratory hours experience
- Limited Production available - September '97

Alternate Fuels Service, Support & Warranty

- Service:
 - PC-based diagnostics
 - maximum parts commonality with base diesel platform
- Support:
 - Installation guidelines & reviews for vehicle manufacturers
 - Cummins distributors / dealers network
 - fleet technician training available
- Warranty:
 - Base engine
 - EPA Emissions: Five years / 100k miles (161,000 km)

North America Distributor Network





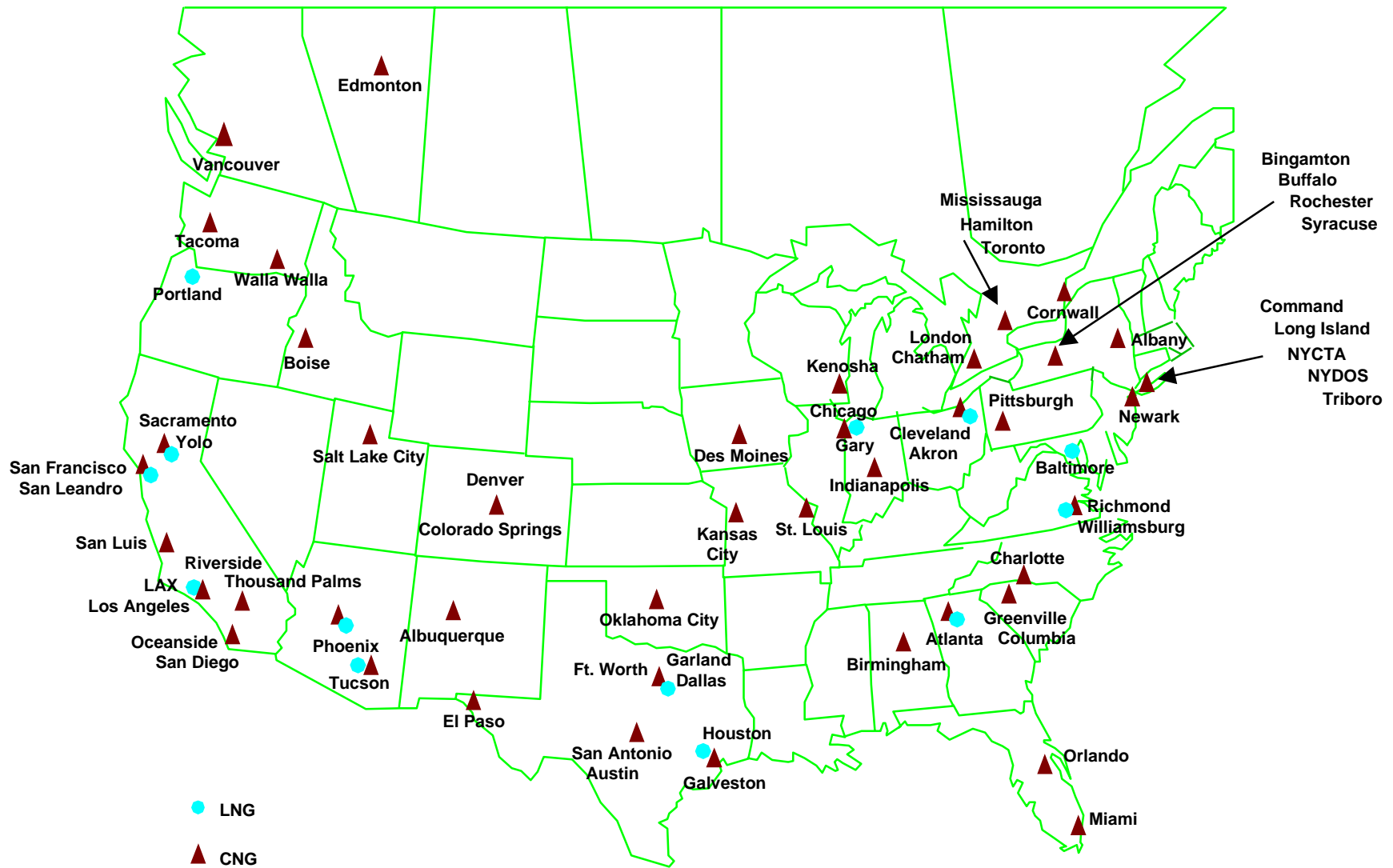
1997 Heavy-Duty Emissions Certifications

Engine	Catalyst	Applications	EPA	Emissions Certification (g/bhp-hr)		
				EPA PM FEL	ARB	ARB Low NOx
B5.9G	Y	All	CFFV ULEV	--	HD	2.5
B5.9G	N	All	CFFV LEV	--	HD	3.5
B5.9LPG	Y	All	CFFV LEV	--	HD	2.5
C8.3G	Y	Automotive	CFFV LEV	--	HD	3.5
C8.3G	Y	Urban Bus	HD	--	HD	--
L10G	Y	Automotive	HD	--	HD	--
L10G	Y	Urban Bus	HD	0.03	HD	--

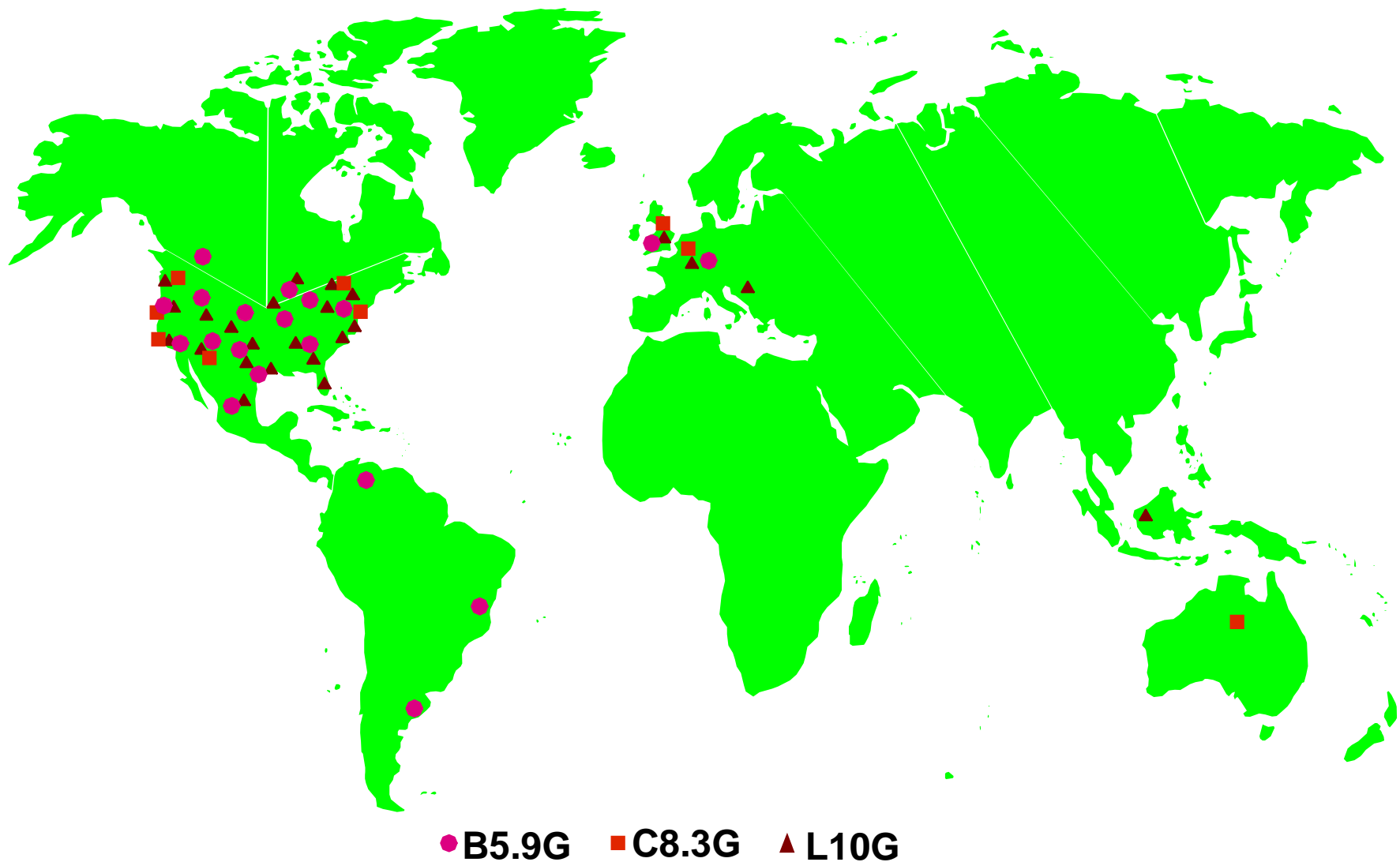
Alternative Fuel (CNG / LNG / LPG) Products

ENGINE PLATFORM	RATED POWER (Hp)	TORQUE PEAK (ft-lb)	AVAILABILITY STATUS
B5.9G	230 @ 2800rpm	500 @ 1600rpm	1/98
	195 @ 2800rpm	420 @ 1600rpm	NOW
	150 @ 2500rpm	375 @ 1500rpm	NOW
B5.9LPG	195 @ 2600rpm	420 @ 1600rpm	NOW
C8.3G	275 @ 2400rpm	750 @ 1400rpm	1/98
	250 @ 2400rpm	660 / 750 @ 1400rpm	NOW
L10G	280 / 300 @ 2100rpm	900 @ 1300rpm	NOW

Natural Gas Fleet Locations



World-Wide Natural Gas Fleet Locations



Alternative Fuels Experience

- Over 2300 NG engines in revenue service with over 130M miles (210M km) experience predominately in bus applications (school / shuttle / transit)
- Medium- / heavy- duty truck experience growing (100 engines with over 1.5M miles experience)
- Engine noise and emissions significantly less than diesel; efficiency 10-25% less than diesel dependent on duty cycle
- OEM integration of vehicle fuel system critical

FOR MORE INFORMATION, CONTACT:

1) Cummins Web Page

(<http://www.cummins.com/bus/altfuels.html>)

2) Local Cummins Distributor / Dealer

3) Jim Branner, Jr. - Cummins Alternate Fuels Group

812-377-4091 (fax -2029)

e-mail: j.l.branner@ctc.cummins.com

